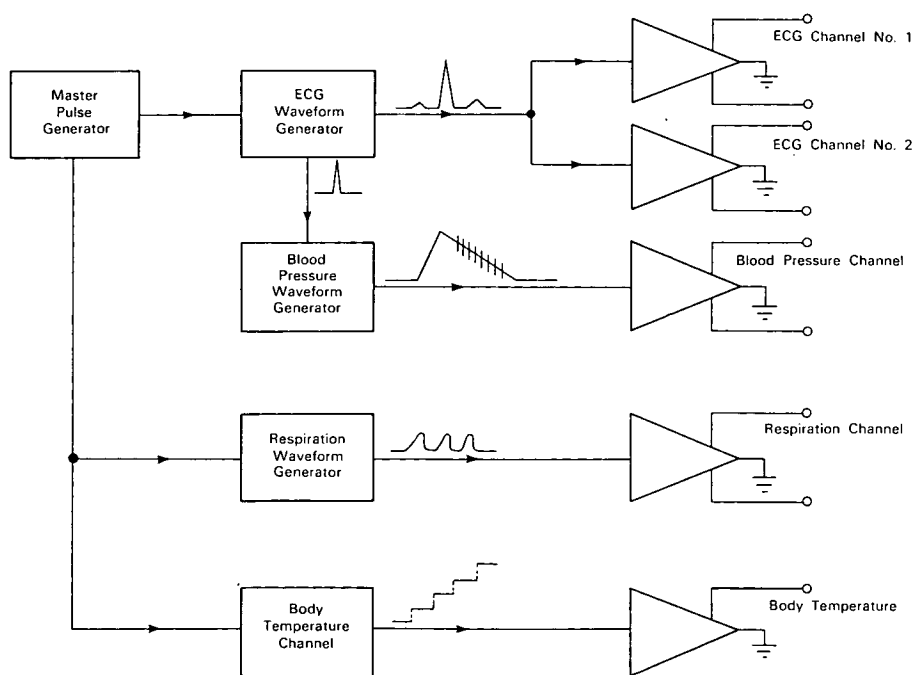


NASA TECH BRIEF



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Simulator Produces Physiological Waveforms



The problem: In the space program, a need existed for an instrument capable of simulating various physiological waveforms at voltage and impedance levels compatible with manned spacecraft telemetry systems. Because of the very low frequency (down to 0.17 cps) components and dc voltage levels involved, conventional magnetic tape systems do not fulfill this need.

The solution: A physiological waveform simulator that produces signals closely approximating those normally picked up by biosensors attached to the human body.

How it's done: The master pulse generator feeds the electrocardiogram (ECG) channels a triangular waveform continuously variable from approximately 35 to 85 beats-per-minute. Monostables in the ECG channels produce fixed-duration square waves. These actuate final wave generators, which, in conjunction with a mixer and trimming potentiometer, feed the two differential amplifiers. The respective outputs are used to simulate an axillary electrocardiogram (ECG No. 1) and a sternal electrocardiogram (ECG No. 2).

An output from the ECG channels feeds the blood pressure channel to produce a composite signal that

(continued overleaf)

is applied to the differential amplifier, the output of which is manually adjustable. The resultant output signal is used to simulate the normal human blood pressure waveform.

For the respiration rate channel, the master pulse generator is an astable (free running) multivibrator. The repetition rate of this waveform is controlled by a three-position switch. After wave shaping by an R-C network, the waveforms are fed to a differential amplifier that controls the signal amplitude and processes the signal to a form compatible with the telemetry system being used. The output of the differential amplifier is used to simulate three human respiration rates, normal under certain discrete stimuli.

The body temperature channel is a high-level, single-ended channel providing dc voltage levels corresponding to six simulated body temperatures—95°, 97°, 99°, 101°, 103°, and 105° F—manually selected by a switch. Simulation of body temperature by manually selecting a voltage analog rather than

using a continuous staircase sweep effects a substantial reduction in circuit complexity.

Notes:

1. This simulator could be used effectively in hospitals, medical research institutes, and medical schools for the propagation and study of typical physiological waveforms and for the checkout of biomedical instrumentation.
2. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Manned Spacecraft Center
P.O. Box 1537
Houston, Texas, 77001
Reference: B65-10091

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Stig Ekeroot
(MSC-94)